9-12 LIFE SCIENCE

October 2013 Volume 1, Issue 1

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NAEP Science Assessment
What Students Know and Can Do in Science

CROSSING CONTENT AND PRACTICES TO GENERATE PERFORMANCE EXPECTATIONS

Science Practices

- **Identifying Science Principles** ("knowing science")
- **Using Science Principles** ("knowing science")
- **Using Scientific Inquiry** ("doing science")
- **Using Technological design** ("doing science")

Performance Expectations

Science Content

- Physical Science
- **Life Science**
- Earth and Space Science

Grade 9-12 NGSS

HS-LS-1. From Molecules to Organisms: Structures and Processes

HS-LS2: Ecosystems: Interactions, Energy, and Dynamics

HS-LS4: Biological Evolution: Unity and Diversity

HS-LS3: Heredity: Inheritance and Variation of Traits

http://www.nextgenscience.org/search-standards-dci

Grade 12 NAEP

Interdependence: consequences of interdependence

Organization and Development: the chemical basis of living systems

Evolution and Diversity: the mechanisms of evolutionary change and the history of life on Earth

Matter and Energy Transformations: the chemical basis of matter and energy transformation in living systems

Heredity and Reproduction: the molecular basis of heredity

http://www.nsta.gov/publications/frameworks/science/2011-science-framework.html

9-12 Life Science Montana OPI Science Standards

Content Standard 1—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Content Standard 6—Students understand historical developments in science and technology.

Content Standard 3—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Content Standard 5—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.

http://opi.mt.gov/pdf/Standards/10ContStds-Science.pdf

This brochure is the creation of Ashley McGrath Montana's NAEP State Coordinator, users should be diligent in checking standards and frameworks for accuracy and appropriateness. For questions, please contact amgrath@mt.gov.

Dimension 2: Crosscutting Concepts in NGSS

CROSSCUTTING CONCEPTS THAT HAVE COMMON APPLICATION ACROSS FIELDS

"*Crosscutting concepts have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas.*"
— A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. p. 233

1. **Patterns**– Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Empirical evidence is needed to identify patterns.

2. **Cause and effect:** Mechanism and explanation– Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

Systems can be designed to cause a desired effect.

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

3. **Scale, proportion, and quantity**– In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.

The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

4. **Systems and system models**– A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.

When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.

Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

NAEP'S science practices are associated with these cognitive demands :

(1) "knowing that,"

(2) "knowing how,"

(3) "knowing why" and

(4) "knowing when and where to apply knowledge."

The practices are (1) Identifying Science Principles, (2) Using Scientific Inquiry, (3) Using Scientific Principles, and (4) Using Technological Design.

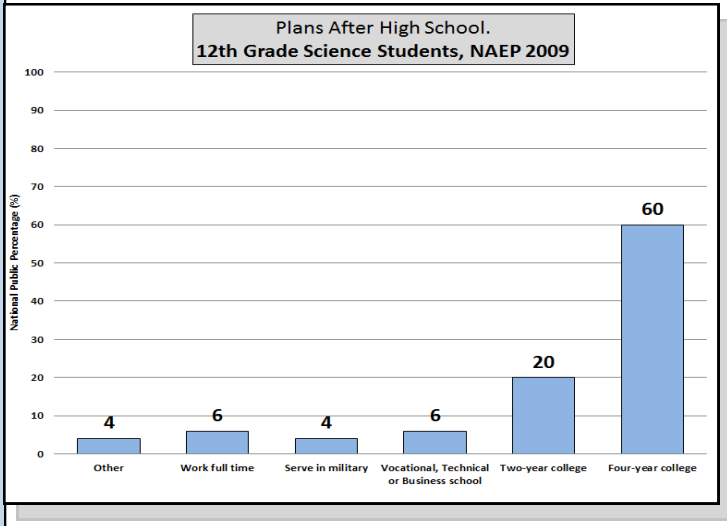
Source: www.nagb.gov (click here)

Points of Interest:

- 12th –graders can do detailed experiments but are challenged to explain their reasoning.
- **64%** of 12th graders could explain their recommendations with valid support based on the materials in the "Maintaining Water Systems" kit.
- **11%** of students were able to provide a valid final recommendation for the "Maintaining Water Systems" by supporting their conclusions with details from the data.
- Female students in grade 12 scored higher than males on the hands-on tasks, though males scored higher on the traditional paper-and-pencil science assessment.

Source:
http://nationsreportcard.gov/science_2009/

Explore NAEP data in the NDE



NOTE: All numbers are rounded and observed differences may not be statistically significant.

For more help on how to obtain NAEP items, please visit Montana's NAEP Wiki at: http://www.opi.mt.gov/groups/montananaep/

OR Click here to access the NAEP Questions Tool (NQT) instructional videos.

*Footnote: All *Crosscutting Concept* information was obtained from: http://www.nextgenscience.org/search-performance-expectations. More examples of crosscutting concepts can be found in the NGSS Appendix G-Crosscutting Concepts.

Dimension 2: Crosscutting Concepts in NGSS

Users should be diligent in checking standards and frameworks for accuracy and appropriateness.

DIMENSION 2: CROSSCUTTING CONCEPTS THAT HAVE COMMON APPLICATION ACROSS FIELDS

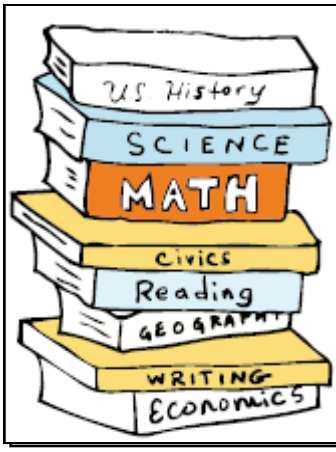
5. **Energy and matter:** Flows, cycles, and conservation– Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
- The total amount of energy and matter in closed systems is conserved.
- Energy drives the cycling of matter within and between systems.
- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
- Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

6. **Structure and Function** – The way an object is shaped or structured determines many of its properties and functions.

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
- The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

37 1/2 % of the Grade 12 (2009) assessment was Life Science, 37 1/2 % Physical Science and 25% Earth and Space Science.

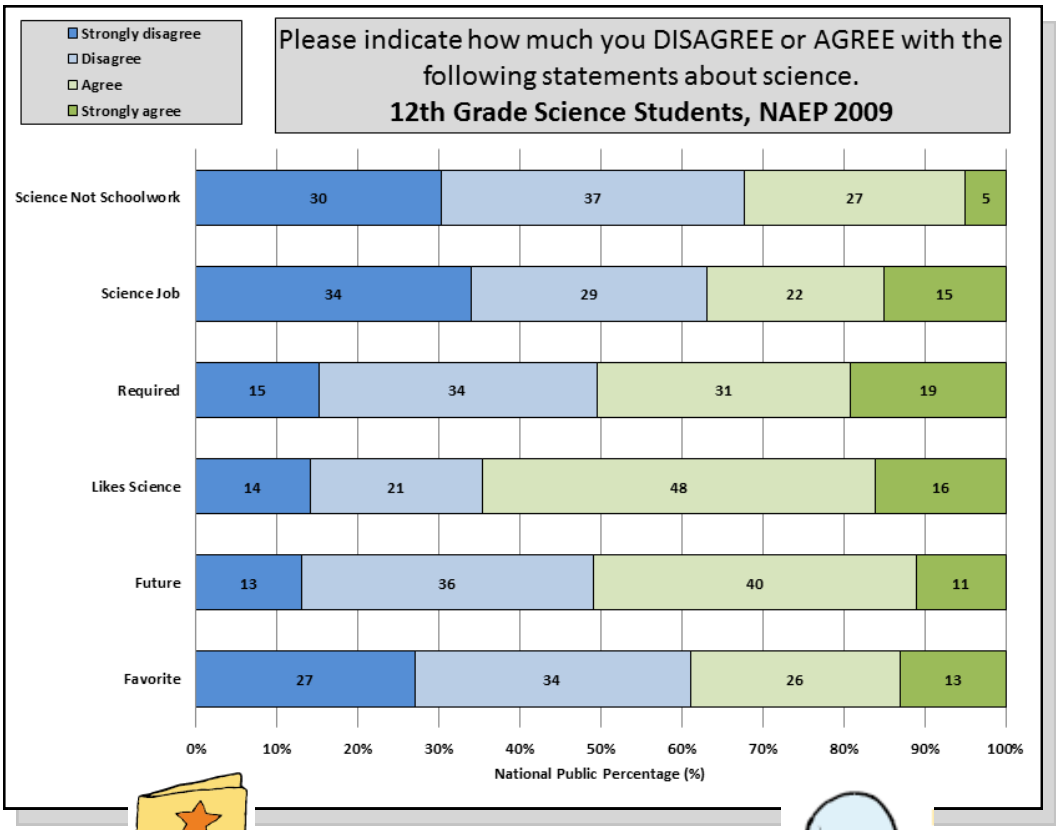


7. **Stability and Change** – For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

- Systems can be designed for greater or lesser stability.
- Feedback (negative or positive) can stabilize or destabilize a system.
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
- Much of science deals with constructing explanations of how things change and how they remain stable.

Classroom contexts. Results from the cognitive items provide information about what students *know* and *can do* in a subject area. Information from the background items gives context to NAEP results and allows researchers to track factors associated with academic achievement. More information can be found **here**, **here** and **here**.

In the life sciences- "students should be able to explain chemical mechanisms for metabolism, growth, and reproduction in living systems; analyze cases of evolutionary change in populations using the following related science principles: the potential of a species to increase its numbers, the genetic variability of its offspring, limitations on the resources required for life, and the ensuing selection of those organisms better able to survive and leave offspring; and use scientific models to explain data patterns related to metabolism, genetics, or changes in ecosystems" (The Nation's Report Card, p.52).



NOTE: Percentages may not add to 100 due to rounding. Off task applies to responses that do not address the question presented, are illegible, or cannot otherwise be scored. SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

The Nation's Report Card

Explore NAEP data in the NDE

Learn

Montana's Content Standard 3: 3.1 and 3.2

Content Standard 3—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

1. Investigate and use appropriate technology to demonstrate that cells have common features including differences that determine function and that they are composed of common building blocks (e.g., proteins, carbohydrates, nucleic acids, lipids)

A. Demonstrate appropriate microscopic techniques (10)

B. Recognize that a variety of microscopes exist (10)

C. Identify common features among all cells(10)
NAEP: L12.1

D. Compare and contrast prokaryotes and eukaryotes (10)
NGSS: HS-LS1-2

E. Compare and contrast the structure, function and relationship of key cellular components (10)
NAEP: L12.1
NGSS: HS-LS1-2

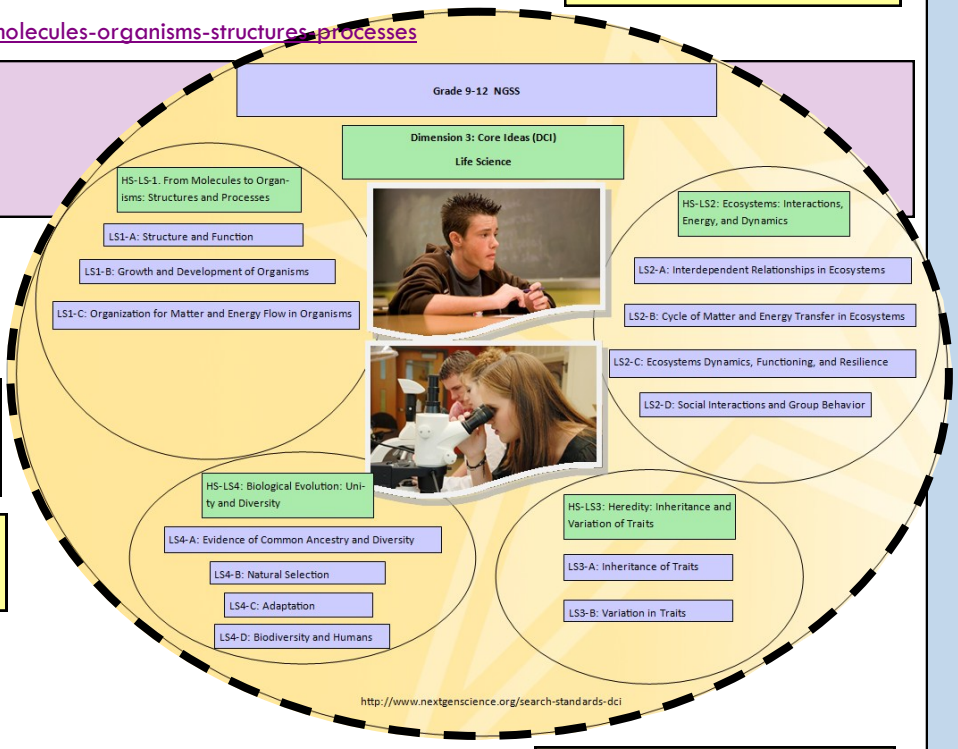
F. Identify key differences between plant and animal cells (10)
NAEP: L12.4

G. Explain how concentration of substances affects diffusion and osmosis (10)

H. Explain the role of key biologically important macromolecules (10)
NAEP: L12.1

http://www.nextgenscience.org/hsls1-molecules-organisms-structures-processes

2. Describe and explain the complex processes involved in energy use in cell maintenance, growth, repair and development



A. Explain and give examples of the importance of a constant internal environment(10)
NAEP: L12.3

B. Identify processes that maintain homeostasis (10)
NAEP: L12.3
NGSS: HS-LS1-3

D. Describe the role of ATP in the body (10)
NAEP L12.6

E. Identify the key components involved in the chemical reaction of cellular respiration (10)
NGSS: HS-LS1-7; HS-LS2-5

H. Summarize the conversion of light energy to chemical energy by photosynthetic organisms (10)
NAEP: L12.4
NGSS: HS-LS1-5

I. Explain the relationship between the products and reactants of photosynthesis and cellular respiration (10)
NAEP: L12.4
NGSS: HS-LS1-5; HS-LS2-5

L. Identify the major events that occur in meiosis (10)
NAEP: L12.3
NGSS: HS-LS1-4

J. Explain the purpose of the cell cycle (10)

K. Describe the stages of mitosis in plants and animals (10)
NAEP: L12.3

M. Differentiate between haploid and diploid chromosome numbers (10)

C. Classify, compare and contrast various organisms as a heterotroph or autotroph (10)
NAEP: L12.4

G. Compare and contrast aerobic and anaerobic respiration (10)
NAEP: L12.6
NGSS: HS-LS2-3

N. Compare and contrast the process and purpose of mitosis and meiosis (10)
NGSS: HS-LS1-4

F. Describe and model the conversion of stored energy in organic molecules into usable cellular energy (ATP) (10)
NAEP 12.1
NGSS: HS-LS2-5; HS-LS1-7

*NGSS: HS-LS1-6 not categorized

http://www.nextgenscience.org/hsls1-molecules-organisms-structures-processes
http://www.nextgenscience.org/hsls2-ecosystems-interactions-energy-dynamics

*Footnote: Green boxes indicate OPI standards, Pink boxes indicate benchmarks and Blue boxes indicate Essential Learning Expectations (ELEs).

Montana's Content Standard 3: 3.3 and 3.4

Content Standard 3—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

3. Model the structure of DNA and protein synthesis, discuss the molecular basis of heredity, and explain how it contributes to the diversity of life

A. Explain the functions of DNA and RNA (10)
NAEP: L12.8
NGSS: HS-LS1-1; HS-LS1-4

B. Compare and contrast the structure of DNA and RNA (10)
NAEP: L12.8
NGSS: HS-LS1-1

C. Identify complementary base pairs (10)
NAEP: L12.8
NGSS: HS-LS1-1

D. Explain the purpose and process of DNA replication (10)
NAEP: L12.8
NGSS: HS-LS1-1; HS-LS1-4; HS-LS3-2

E. Explain the purpose and process of transcription and translation (10)
NAEP: L12.9; L12.2
NGSS: HS-LS1-4; HS-LS1-1

F. Explain the relationship between DNA and heredity (Central Dogma) (10)
NAEP: L12.10; L12.2; L12.9
NGSS: HS-LS1-1; HS-LS1-4; HS-LS3-2

G. Summarize the law of segregation and the law of independent assortment (10)
NAEP: L12.10; L12.8

H. Summarize how the process of meiosis produces genetic recombination (10)
NAEP: L12.10; L12.8

I. Explain the difference between dominant and recessive alleles (10)
NAEP: L12.10; L12.8

J. Distinguish between genotype and phenotype (10)
NAEP: L12.8; L12.10

K. Use the law of probability and punnett squares to predict genotypic and phenotypic ratios (10)
NAEP: L12.10

L. Identify and explain the different ways in which alleles interact to determine the expression of traits (10)
NAEP: L12.8; L12.10
NGSS: HS-LS3-2

M. Distinguish between sex chromosomes and autosomes (10)
NAEP: L12.8

N. Explain how sex linked inheritance influences some genetic traits (10)
NAEP: L12.10

O. Define genetic mutations (10)
NAEP: L12.9
NGSS: HS-LS3-2

P. Identify some of the major causes of mutations (10)
NAEP: L12.9
NGSS: HS-LS3-2

Q. Explain how mutations influence genetic expression (10)
NAEP: L12.9
NGSS: HS-LS3-2

R. Explain the results of nondisjunction (10)
NAEP: L12.9
NGSS: HS-LS3-2

4. Predict and model the interaction of biotic and abiotic factors that affect populations through natural selection, and explain how this contributes to the evolution of species over time

A. Differentiate between biotic and abiotic factors in ecosystems (10)
NAEP: L12.5
NGSS: HS-LS-3

B. Discuss how abiotic and biotic factors influence biomes (10)
NAEP: L12.5
NGSS: HS-LS2-2

C. Explain biogeochemical cycles (10)
NGSS: HS-LS2-5

D. Recognize that the sun is the ultimate source of energy in MOST ecosystems (10)
NAEP: L12.5
NGSS: HS-LS2-3; HS-LS1-5

E. Explain the difference between a food chain and food web. (10)
NAEP: L12.5

F. Explain trophic levels and pyramids in terms of energy transfer, biomass and number of individuals (10)
NAEP: L12.5
NGSS: HS-LS2-2; HS-LS2-4; HS-LS2-3

G. Identify and predict density dependent and density independent factors that impact a population (10)
NAP: L12.7; L12.13
NGSS: HS-LS3-3; HS-LS2-1; HS-LS2-8; HS-LS4-2; HS-LS4-5

H. Describe predator-prey dynamics (10)
NAEP: L12.13; L12.7
NGSS: HS-LS2-8; HS-LS4-2; HS-LS4-5

I. Compare and contrast the symbiotic relationships that exist between species (10)
NAEP: L12.7

K. Recognize that evolution involves a change in allele frequencies in a population across successive generations (10)
NAEP: L12.12; L12.7; L12.13
NGSS: HS-LS4-3; HS-LS4-2; HS-LS3-3

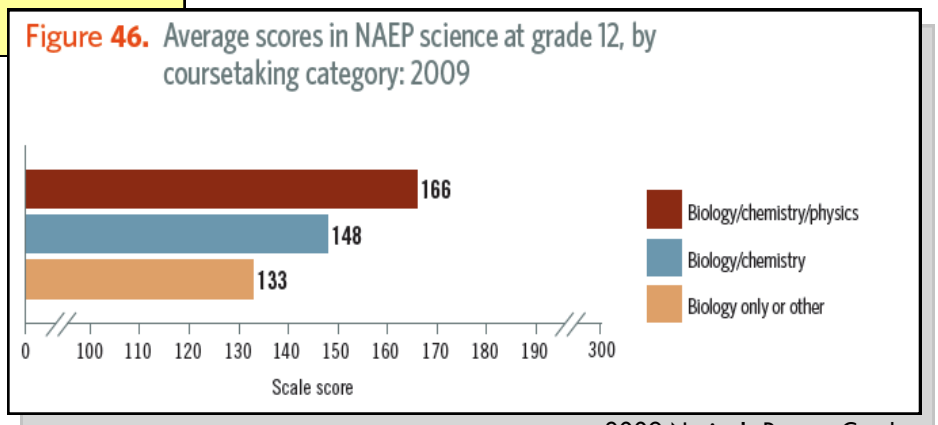
L. Model and explain how natural selection can change a population (10)
NAEP: L12.12; L12.7; L12.13
NGSS: HS-LS4-2; HS-LS4-3; HSLS4-4; HS-LS4-5; HS-LS3-3

M. Describe the major factors that influence speciation (10)
NAEP: L12.7; L12.13
NGSS: HS-LS4-1

N. Explain the theory of evolution by natural selection (10)
NAEP: L12.13; L12.11; L12.7
NGSS: HS-LS4-1; HS-LS4-4

J. Describe how communities progress through a series of changes (succession) (10)
NAEP: L12.7
NGSS: HS-LS2-6

*NGS: HS-LS2-7; HS-LS4-6 not categorized



2009 Nation's Report Card.

http://www.nextgenscience.org/hsls2-ecosystems-interactions-energy-dynamics
http://www.nextgenscience.org/hsls3-heredity-inheritance-variation-traits
http://www.nextgenscience.org/hsls4-biological-evolution-unity-diversity

*Footnote: Green boxes indicate OPI standards, Pink boxes indicate benchmarks and Blue boxes indicate Essential Learning Expectations (ELEs).

Montana's Content Standards 3.5 and NAEP Practices

Content Standard 3—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

5. Generate and apply biological classification schemes to infer and discuss the degree of divergence between ecosystems

- A. List and explain the characteristics of the three domains (10)
- B. Compare and contrast the key
- C. Explain how similarities and differences in the key characteristics of each kingdom indicate the degree of divergence between them (10)
- D. Explain the classification of living organisms from the domain to species level(10)
- E. Explain the importance of binomial nomenclature (10)
- F. Generate and use a dichotomous key (10)
- G. Differentiate between vascular and nonvascular plants
- H. Explain the difference between angiosperms and gymnosperms
- I. Compare and contrast major animal phyla
- J. Compare and contrast body systems between major animal phyla

Grade 12 NAEP Practices

Identifying Science Principles

1. Describes, measure, or classify observations.
2. State or recognize correct science principles.
3. Demonstrate relationships among closely related science principles.
4. Demonstrate relationships among different representations of principles.

Using Science Principles

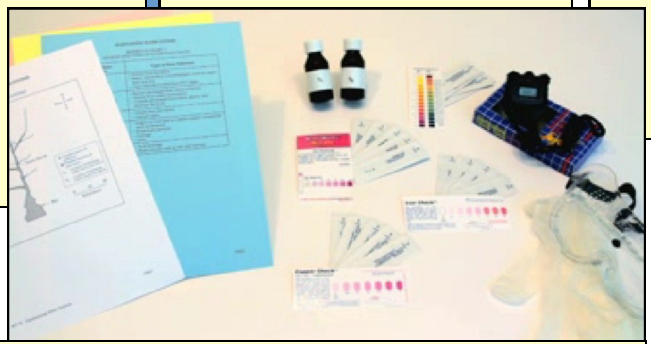
1. Explain observation of phenomena.
2. Predict observations of phenomena.
3. Suggest examples of observations that illustrate a science principle.
4. Propose, analyze, and/or evaluate alternative explanations or predictions.

Hands-On Task—Maintaining Water Systems

Step 1: Predict
64% of students explained their preliminary recommendations with valid support based on the materials in their kits.

Step 2: Observe
75% of students could perform a straightforward investigation to test the water samples and accurately tabulate data.

Step 3: Explain
11% of students were able to provide a valid final recommendation by supporting their conclusions with details from the data.



Step 4 and 5: Extend
14% were able to correctly evaluate water treatment steps and select those that would be needed to remove pollutants that exceed national drinking water standards.
28% of students were able to describe scientific processes used to remove water pollutants.

Grade 12 Hands-On Tasks: Plant Pigments and Maintaining Water Systems.

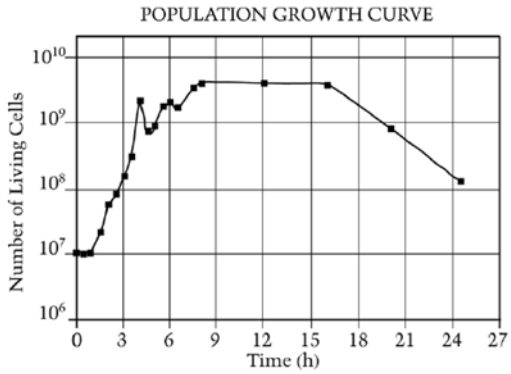
Explore the Tasks

Use released NAEP Questions, available in the NAEP Questions Tool

The following question refer to the growth of bacteria.

A scientist studied the growth rate of a species of bacterium. The scientist introduced some of the bacteria into a flask of nutrient-rich solution and monitored the growth of the bacterial population by measuring the number of living cells in the solution.

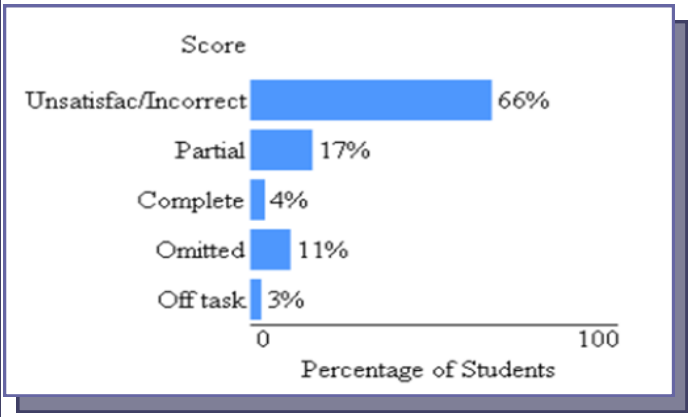
The graph below shows the growth of the bacterial population over time in hours (h).



1. The scientist wanted to determine the effect of an antibiotic on the growth of the bacterium. To a second flask of nutrient-rich solution with the bacterial cells, he added the antibiotic, and monitored the growth of the bacterial population.

   The data showed that most of the bacteria in the solution died, but some survived. The scientist concluded that some of the bacteria were resistant to the antibiotic.

   Explain why some of the bacteria were resistant to the antibiotic, based on the theory of evolution.



NOTE: These results are for public and nonpublic school students. Percentages may not add to 100 due to rounding. Off task applies to responses that do not address the question presented, are illegible, or cannot otherwise be scored.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Complete
Student response correctly explains that some of the bacteria resistant to the antibiotic had a genetic mutation. The resistant bacteria divided passing the genetic mutation to the next generation.

Partial
Student response indicates that some of the bacteria resistant to the antibiotic had a genetic mutation.

OR

Student response indicates that the resistant bacteria divided, passing the genetic mutation to the next generation.

Unsatisfactory/Incorrect
Student response is inadequate or incorrect.

In the process of evolution, some members of a species may develop mutations that variate from the rest of the group. In some cases this mutation makes these members more able, or "fitter," to survive. Thus, survival of the fittest determines who lives and who dies.

NOTE: Regular type denotes a constructed-response question. Italic type denotes a multiple-choice question. The position of a question on the scale represents the scale score attained by students who had a 65 percent probability of successfully answering a constructed-response question, or a 74 percent probability of correctly answering a four-option multiple-choice question. SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment

GRADE 12 NAEP SCIENCE ITEM MAP

	Scale score	Content area	Question description
	300		
Advanced	292	Life science	Explain the cellular response to an external stimulus
	280	Physical science	*Identify nuclear force*
	269	Life science	Critique a conclusion about photosynthesis based on observations (**shown on pages 56 and 57**)
	244	Physical science	*Recognize a nuclear fission reaction*
	232	Earth and space sciences	*Compare methods for determining the age of the Earth*
	222		
Proficient	221	Physical science	*Explain a physical property in molecular terms*
	215	Physical science	Provide evidence of nuclear structure
	212	Earth and space sciences	*Identify a characteristic that distinguishes stars from planets*
	204	Life science	*Order levels of organization in living systems*
	198	Physical science	*Relate motion to conversion of kinetic energy to potential energy* (**shown on page 55**)
	194	Physical science	*Predict motion when unbalanced forces are applied*
	188	Earth and space sciences	Explain an alternative hypothesis about the effect of emissions released into the atmosphere
	186	Life science	Evaluate two methods to help control an invasive species
	184	Life science	*Draw a conclusion based on gases released during photosynthesis and respiration*
	180	Physical science	*Draw a conclusion based on observed physical properties*
	179		
Basic	178	Life science	*Predict the genetic makeup of individuals*
	177	Physical science	*Recognize atomic particles in an ion*
	176	Earth and space sciences	Predict differences in climate based on topography
	174	Earth and space sciences	*Draw a conclusion about the age of a sediment layer based on data*
	168	Physical science	*Solve a design problem related to the electric force between objects*
	167	Life science	*Recognize a useful product of photosynthesis*
	159	Life science	Predict the effect of a major disruption to a trophic level of an ecosystem
	155	Earth and space sciences	*Indicate a geologic event that explains a rock formation* (**shown on page 58**)
	150	Physical science	Improve the accuracy of an investigation about conservation of energy
	148	Physical science	*Relate an observation of a gas to molecular motion*
	143	Life science	*Determine relationships between species based on an evolutionary tree*
	142		
	135	Earth and space sciences	Design and evaluate a trade-off of a method to obtain drinking water
	128	Life science	*Draw a conclusion about population growth based on data*
	120	Physical science	Relate differences in chemical properties to differences in chemical bonds
	106	Physical science	*Interpret a motion graph*
	96	Life science	*Identify evidence to determine heredity*
	74	Life science	*Determine degree of relatedness based on traits*
	0		

2009 Nation's Report Card.

The following question refer to the following experiment.

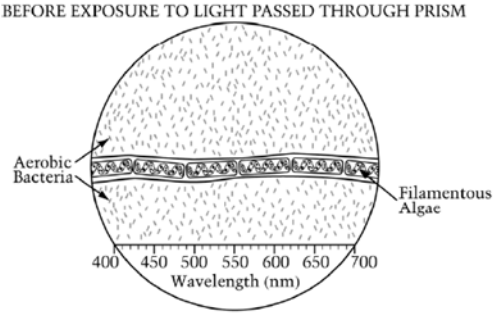
An experiment was conducted to determine which wavelengths of visible light are most effective for photosynthesis. The units shown here are in nanometers (nm).

Two organisms were used: filamentous algae, which are capable of photosynthesis, and some aerobic bacteria, which are not capable of photosynthesis.

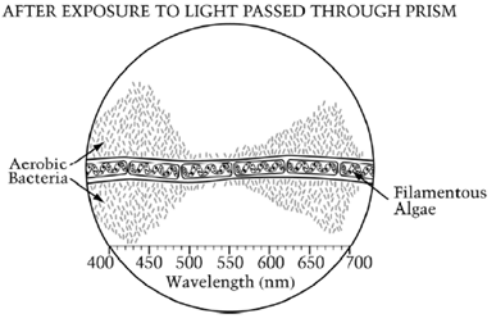
Both organisms were suspended in a water droplet and placed on a microscope slide. The slide was exposed to light that was passed through a crystal prism. (The prism was used to separate visible light into its wavelengths.)

The diagram below illustrates what was seen on the microscope slide before and one hour after exposure to light that was passed through the prism.

BEFORE EXPOSURE TO LIGHT PASSED THROUGH PRISM



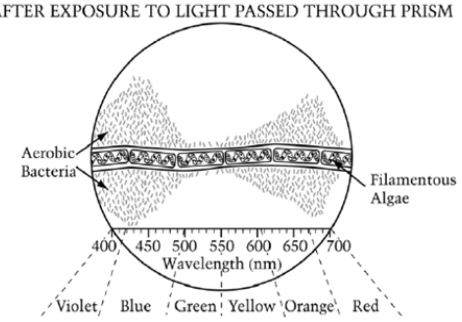
AFTER EXPOSURE TO LIGHT PASSED THROUGH PRISM



Critique a conclusion about photosynthesis based on observations

3. The diagram below illustrates what was seen on the microscope slide one hour after exposure to light that was passed through a prism. The colors associated with the wavelengths of light are also indicated.

AFTER EXPOSURE TO LIGHT PASSED THROUGH PRISM



Based on the results of the experiment, a student concludes that the scientist used algae that was green.

Do you agree with the student's conclusion?

A. Yes
B. No

Refer to the results from the experiment to support your answer.

Do you agree with the student's conclusion?

● Yes

◉ No

Refer to the results from the experiment to support your answer.

If the algae was green, then it would have reflected the green light rather than absorbing it for photosynthesis. It is obvious that the algae didn't conduct any photosynthesis at the green light given the small amount of bacteria located in that spectrum. Therefore the algae must have been green.

Complete
Student response selects (A) Yes and provides a correct explanation that consists of three parts:
- explains that green light is not used or least effective for photosynthesis
- refers to the data that very few bacteria are clustered between 500-550 nm or the green region
- indicates that green light could be reflected or not absorbed

Essential
Student response selects (A) Yes and addresses two parts of a correct explanation.

OR

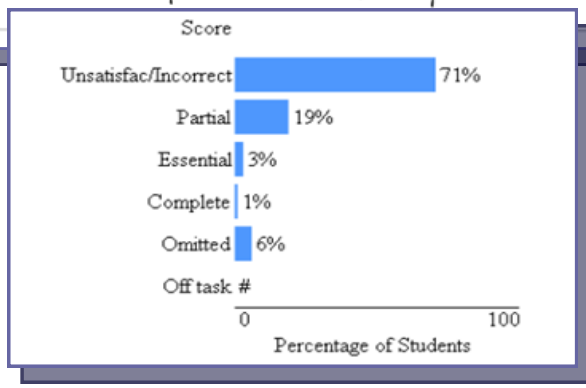
Student response does not select (A) but addresses three parts of a correct explanation.

Partial
Student response indicates (A) Yes and addresses one part of a complete response correctly.

OR

Student response selects (B) No or makes no selection, but addresses one or two parts of a complete response correctly.

Unsatisfactory/Incorrect
Student response is inadequate or incorrect.



Rounds to zero.

NOTE: These results are for public and nonpublic school students. Percentages may not add to 100 due to rounding. Off task applies to responses that do not address the question presented, are illegible, or cannot otherwise be scored.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Percentage of answers rated as "Complete," "Essential," and "Partial" for twelfth-grade students at each achievement level: 2009

Scoring level	Overall	Below *Basic*	At *Basic*	At *Proficient*	At *Advanced*
Complete	1	#	#	3	‡
Essential	3	#	1	13	‡
Partial	19	5	21	42	‡

2009 Nation's Report Card.

http://nationsreportcard.gov/science_2009/ict_tasks.aspx

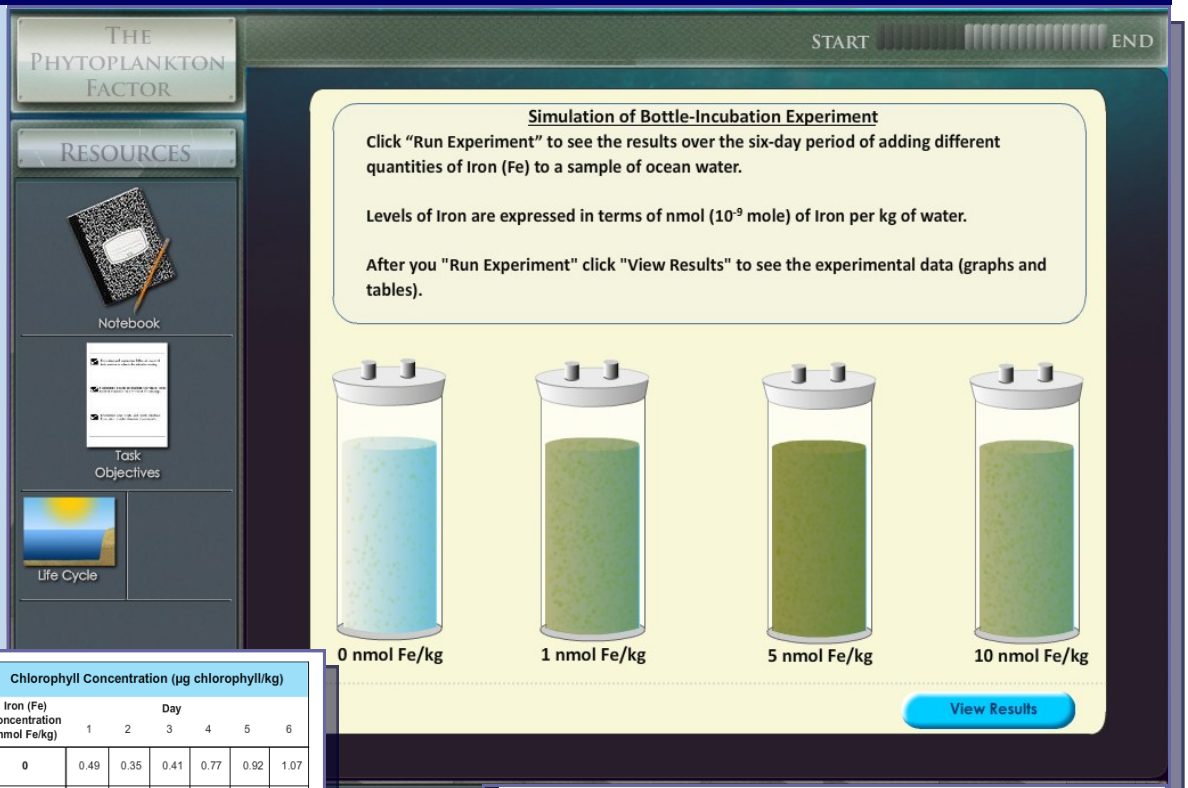
Grade 12 Phytoplankton Factor

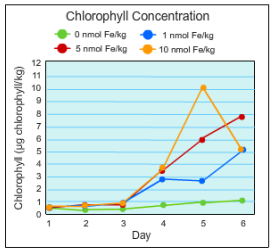
Investigate ocean conditions that support phytoplankton growth

Total of 15 questions for the 40 minute extended task.

⇒ Supplies student with their answer and the correct answer at the conclusion of the test.

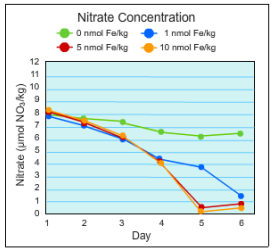
⇒ Answers for grade 12 national students is shown in a table.





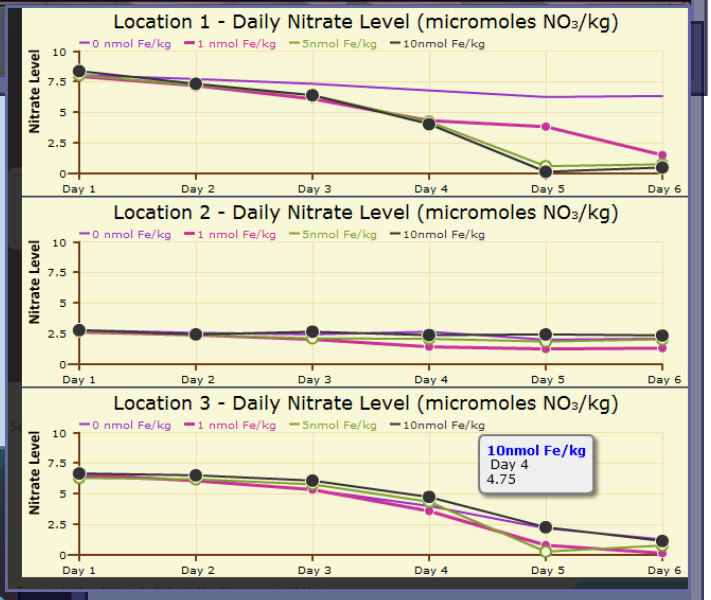
Chlorophyll Concentration (µg chlorophyll/kg)

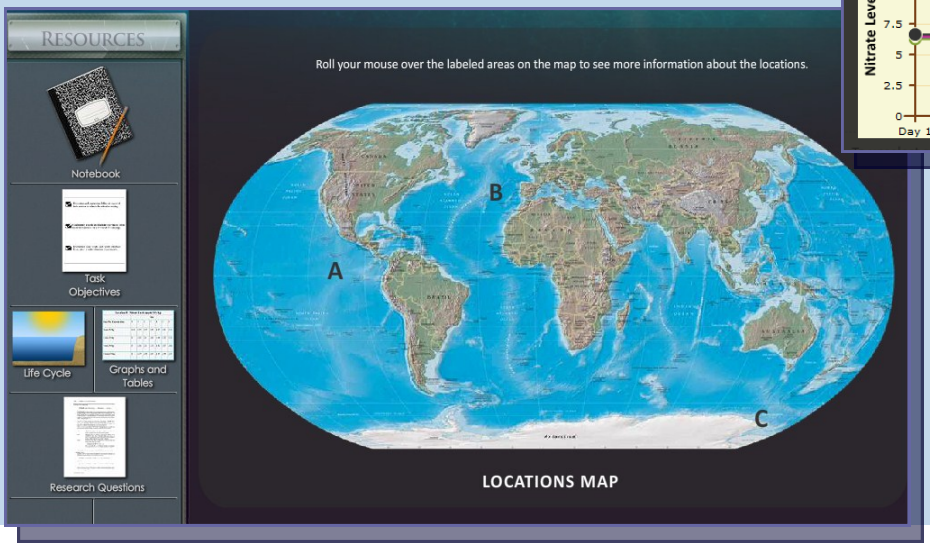
Iron (Fe) Concentration (nmol Fe/kg)	Day 1	2	3	4	5	6
0	0.49	0.35	0.41	0.77	0.92	1.07
1	0.46	0.68	0.84	2.98	2.77	5.21
5	0.52	0.67	0.67	3.31	5.97	7.91
10	0.46	0.77	0.84	3.85	10.16	5.26



Nitrate Concentration (µmol NO_3/kg)

Iron (Fe) Concentration (nmol Fe/kg)	Day 1	2	3	4	5	6
0	8.04	7.72	7.34	6.80	6.25	6.34
1	7.94	7.19	6.10	4.32	3.84	1.51
5	8.03	7.22	6.40	4.24	0.60	0.75
10	8.37	7.34	6.40	4.04	0.15	0.50





Grade 12 Interactive Computer Tasks (ICTs): Starlight, Energy Transfer and The Phytoplankton Factor.

Explore the Tasks

NAEP Questions Tool

The questions in the NAEP Questions Tool are presented for the use of teachers, parents, students, and others as: (1) examples of what NAEP asks students at grades 4, 8, and 12 for main NAEP, and at ages 9, 13, and 17 for long-term trend; (2) exemplars of questions that probe students' knowledge of a specific content area; and (3) a way to compare an individual's performance on a specific question to that of the students across the nation and in the state. For more information, visit http://nces.ed.gov/nationsreportcard/itmrlsx/landing.aspx

NAEP Item Maps

Item maps help to illustrate what students know and can do in NAEP subject areas by positioning descriptions of individual assessment items along the NAEP scale at each grade level. An item is placed at the point on the scale where students are more likely to give successful responses to it. The descriptions used in NAEP item maps focus on the knowledge and skills needed to respond successfully to the assessment item. For more information, visit http://nces.ed.gov/nationsreportcard/itemmaps/index.asp

Test yourself

Try sample questions in a variety of subjects for yourself. At the end of the quiz, see how students across the nation performed. For more information, visit http://nationsreportcard.gov/testyourself.asp

Interactive Computer Tasks (ICTs)

These tasks presented students with computer-based environments where students were asked to solve authentic scientific problems. There are nine released ICTs available to the public. For more information, visit http://nationsreportcard.gov/science_2009/ict_tasks.asp

Hands-On Tasks (HOTs)

These tasks gave students real-world contexts where students were asked to demonstrate how well they are able to plan and conduct scientific investigations, reason through complex problems, and apply their scientific knowledge. There are three released HOTs available to the public. For more information, visit http://www.youtube.com/watch?v=6RNpps7zdlE&list=PLkEhwZQdyNEEF3ayHdye-kweX7DyF3Awb&index=5

Introducing NAEP to Teachers

Educators explaining the importance of NAEP, the relevance of NAEP and how it applies to teachers. For more information, visit http://www.youtube.com/watch?v=zR1_pUdSlFg&list=PLkEhwZQdyNEEF3ayHdye-kweX7DyF3Awb&index=1
Create your own NAEP test and see what students know and can do. For more information, visit http://nationsreportcard.gov/educators.asp

Images property of NAEP; NAEP frameworks, data and assessment results were taken from NAGB, the Main NAEP NDE, NQT and The Nation's Report Card: 2009.

NAEP items can be used as a helpful educational resource in the classroom. Teachers can use the NAEP Questions Tool to see how students' performance compares on specific items. You can also request any information or specific research data from your NAEP State Coordinator, **Ashley McGrath at amcgrath@mt.gov.**

NAEP Webpage: http://opi.mt.gov/Reports&Data/NAEP.html

NAEP Wiki: http://opi.mt.gov/groups/montananaep/

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